SERDP-ESTCP Research and Development in Protective Coatings

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ESTCP

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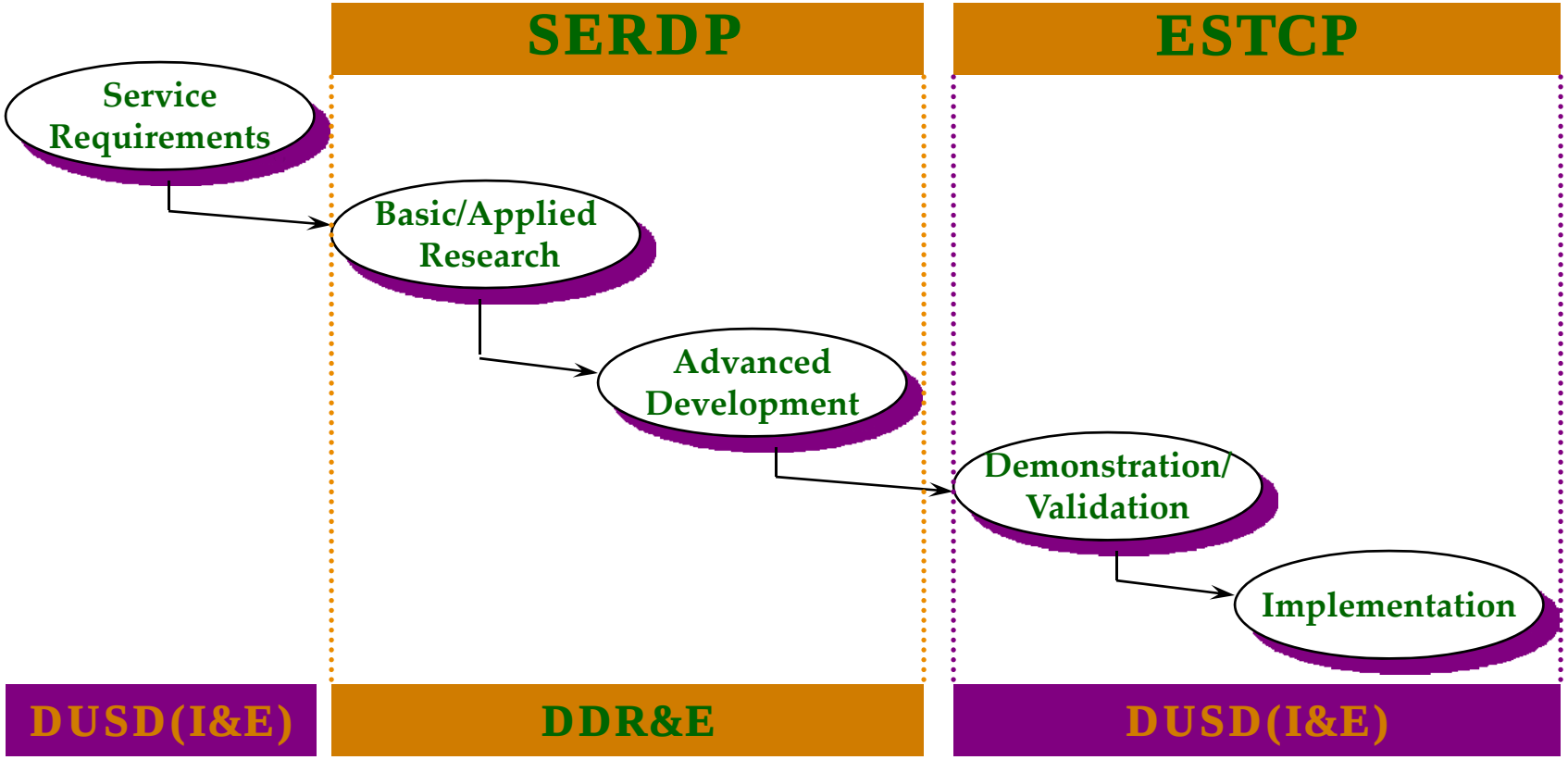
Environmental Technology Development Process



REGULATORY COOPERATION

Management Process

SERDP Method

- **Annual Solicitations to Meet DoD Needs**
  - **Two Solicitations**
  - **Open to All: Government, Academia, Industry**
- **Competitive Award**
  - **External Peer Review**
  - **Internal and Scientific Advisory Board Review**
- **Transition to Demonstration/Validation**

Environmental Security Technology Certification Program

PROGRAM GOALS

- **Demonstrate innovative cost-effective environmental technologies**
  - **Capitalize on past investments**
  - **Transition technology out of the lab**
- **Promote implementation**
  - **Direct technology insertion**
  - **Gain regulatory acceptance**

Priority: needs of the DoD user community

ESTCP Method

- **Partner with stakeholders and test at DoD facilities**
  - **Developer, regulators, end-user**
  - **Direct transition**
- **Validate operational cost and performance**
  - **Independent test and evaluation**
  - **Satisfy regulatory and user communities**
- **Identify DoD market opportunities**
  - **Technology transfer across federal and private sector**

Weapons Systems and Platforms

- **Manufacturing and Maintenance**
  - Green materials and processes (principally related to surface engineering technologies)
  - Control and monitoring
    - Depots, Field, Shipyards & OEM
- **Green Energetics**
  - New Materials
  - Alternative Manufacturing
- **Air and Noise Emissions**
  - Diesels and Gas Turbines
  - Weapons and Munitions
  - Ship and Industrial

Partner with Acquisition and Maintenance Community

SERDP Statements-of-Need Related to Coatings Since 2003

FY2003

- Chromium-Free Coating Systems for DoD Applications
- Environmentally Acceptable Alternatives for Liquid Spray Paint Pre-Mix Components
- Environmentally Benign Methods for the Removal of Radar Absorbing Material Coatings

FY2004

- Environmentally Benign Alternatives for Cadmium Plating on High Strength Steels

SERDP Statements-of-Need Related to Coatings Since 2003

FY2005

- Environmentally Benign Medium Caliber Gun Barrels

FY2006

- Environmentally Benign Finishing/Coating Systems for DoD Substrates

FY2008

- Environmentally Benign, High-Strength Fasteners for Weapons Systems
- Scientific Understanding of Non-Chromated Corrosion Inhibitors Function

SERDP Statements-of-Need Related to Coatings Since 2003

FY2009

- Dynamic Accelerated Corrosion Test Protocol
- Environmentally Acceptable, Direct-to-Substrate Pretreatments for Multi-Material Systems
- Understanding the Science Behind How Methylene Chloride/Phenolic Chemical Paint Strippers Remove Coatings

FY2010

- Environmentally Benign, High-Performance Non-Media Paint Strippers

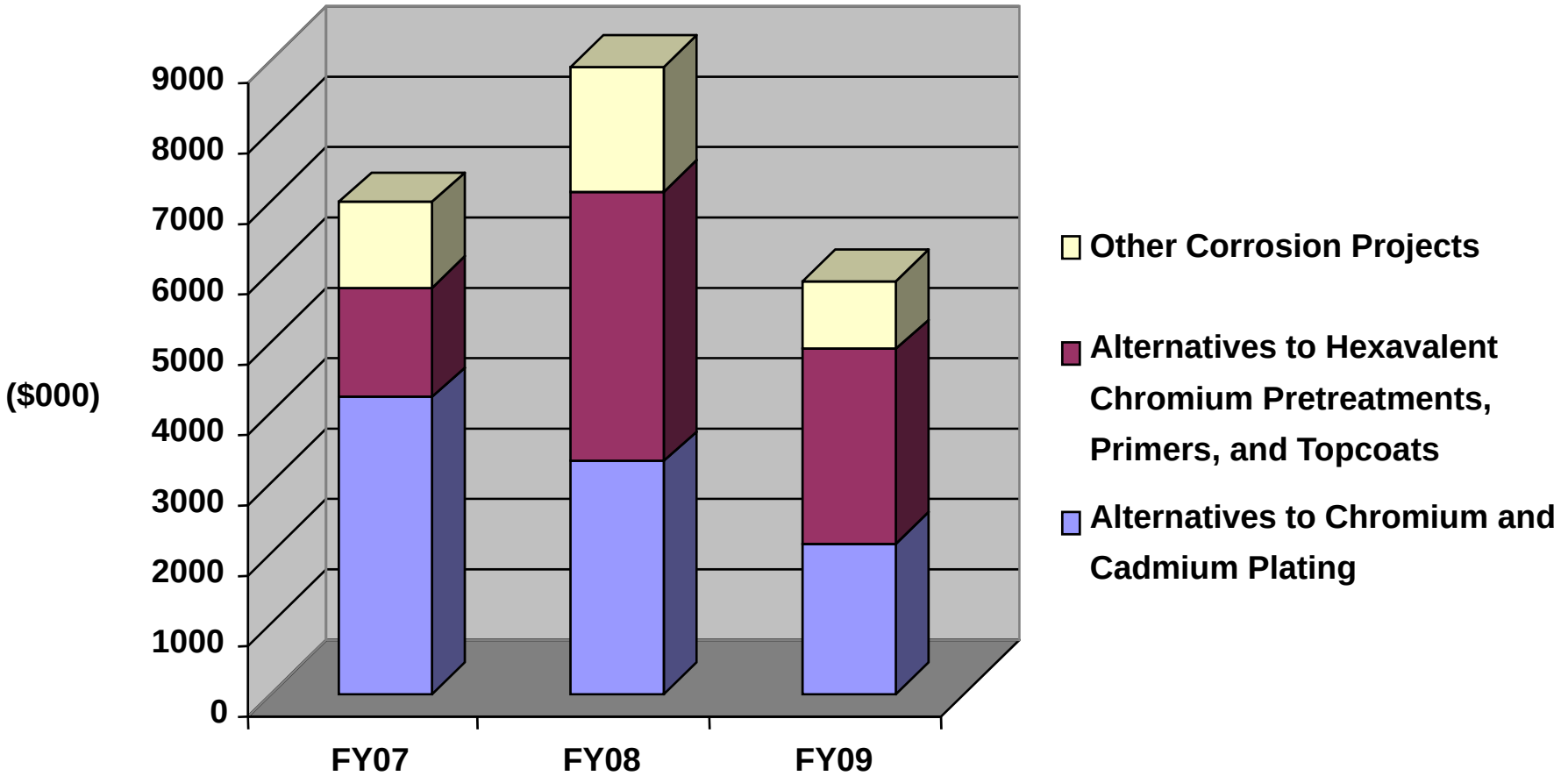
Selected ESTCP Projects Related to Coatings

- **FY2000: *Non-chromate Aluminum Pre-treatments* (NAVAIR Pax River)**
- **FY2001: Replacement of Hard Chrome Plating on Helicopter Dynamic Components (Naval Research Lab)**
- **FY2005: *Validation of Novel Electroactive Polymers as Environmentally Compliant Coatings for Replacement of Hexavalent Chromium Pretreatments* (NAVAIR China Lake)**
- **FY2006: *Supersonic Particle Deposition for Repair of Magnesium Components* (Army Research Lab)**
- **FY2006: *Low Temperature Powder Coatings* (Hill AFB)**
- **FY2007: *Joint DOD Demonstration and Validation of Magnesium Rich Primer Coating Technology* (NAVAIR Pax River)**
- **FY2008: *Ultraviolet Curable Powder Coatings* (AFRL)**
- **FY2008: *Ultraviolet Curable Coatings for Aerospace Applications* (Hill AFB)**

Selected ESTCP Projects Related to Coatings

- **FY2009:** ***Validation/Demonstration of Anti-Corrosion Inhibitor Primer Formulations as Replacements for Hexavalent Chromium Military Primer Coatings*** **(NAVAIR China Lake)**
- **FY2009:** ***Non-Chromate, ZVOC Coatings for Steel Substrates on Army and Navy Aircraft and Ground Vehicles*** **(Army Research Lab)**
- **FY2009:** ***Electrodeposition of Nanocrystalline Co-P Coatings as a Hard Chrome Plating Alternative*** **(Naval Air Depot Jacksonville)**
- **FY2010:** ***Electrocoat Process for Non-Chromate Primers in DoD Manufacturing*** **(NAVAIR Pax River)**
- **FY2010:** ***Self-Sealing Fastener Technology for Reduction of Hazardous Materials*** **(NAVAIR Pax River)**

SERDP/ESTCP Investments Related to Corrosion

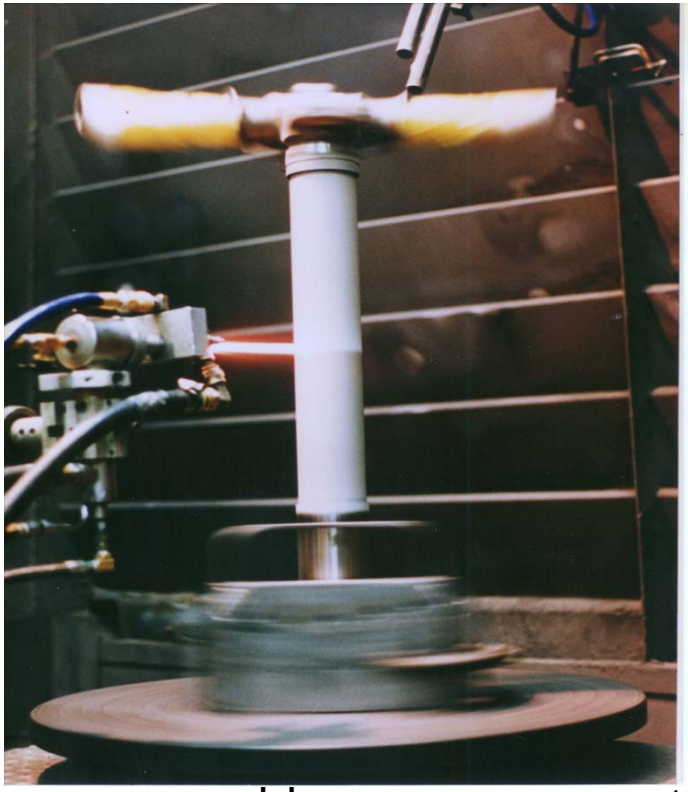


$70M over the last 10 years

Qualification of HVOF Coatings on Different Types of Aircraft Components

- **Separate ESTCP projects were executed for EHC replacement related to:**
  - **Landing Gear**
  - **Propeller Hub Components**
  - **Hydraulic Actuators**
  - **Gas Turbine Engine Components**
  - **Helicopter Dynamic Components (rotor heads, transmissions, gearboxes, etc.)**
- **Projects ran from 1996-2006**

HVOF Thermal Spraying of WC/17Co onto nose landing gear cylinder



HVOF Implementation - Military aircraft

- Joint Strike Fighter (F-35) landing gear – all variants
- Hill Air Force Base (Ogden Air Logistics Center) putting HVOF into production on hundreds of landing gear components on various types of aircraft
- Boeing X-45C UCAV has some HVOF WC-CoCr coated landing gear components
- F-18 steering covers and shock absorber piston heads with Tribaloy 400
- CH-53 blade damper internal-surface coatings of Tribaloy 400 have been approved
- C-17 nose landing gear post: HVOF WC-Co has replaced hard chrome to prevent heat-burning
- F-22 convergent nozzle actuators: shafts coated with WC-Co, internal surfaces coated with Tribaloy 400 alloy.

HVOF Implementation – Commercial Aircraft

- All new Canadian landing gear designs specified with HVOF WC-CoCr
  - 4 HVOF shops set up to meet demand
- In commercial use for
  - Boeing 767-400
  - Boeing 787
  - Airbus A380
- Maintenance, Repair and Overhaul
  - Boeing has approved for thickness < 0.015”
  - Delta now using for maintenance
  - HVOF now used for repair of flap tracks

Hexavalent Chromium Policy Memo

- Signed by Undersecretary of Defense for Acquisition, Technology and Logistics
- Coordinated through the services, DDR&E, and Corrosion Prevention and Control Office
- Directs Military Departments to:
  - Invest in R&D
  - Ensure testing and qualification procedures funded for alternatives
  - Approve use of alternatives where they can perform adequately
  - Update technical documents and specs to authorize use of qualfied alternatives
  - Document hex-Cr risk analyses in PESHE
  - Require PEO to certify required use of hex-Cr on new systems or for maintenance of legacy systems

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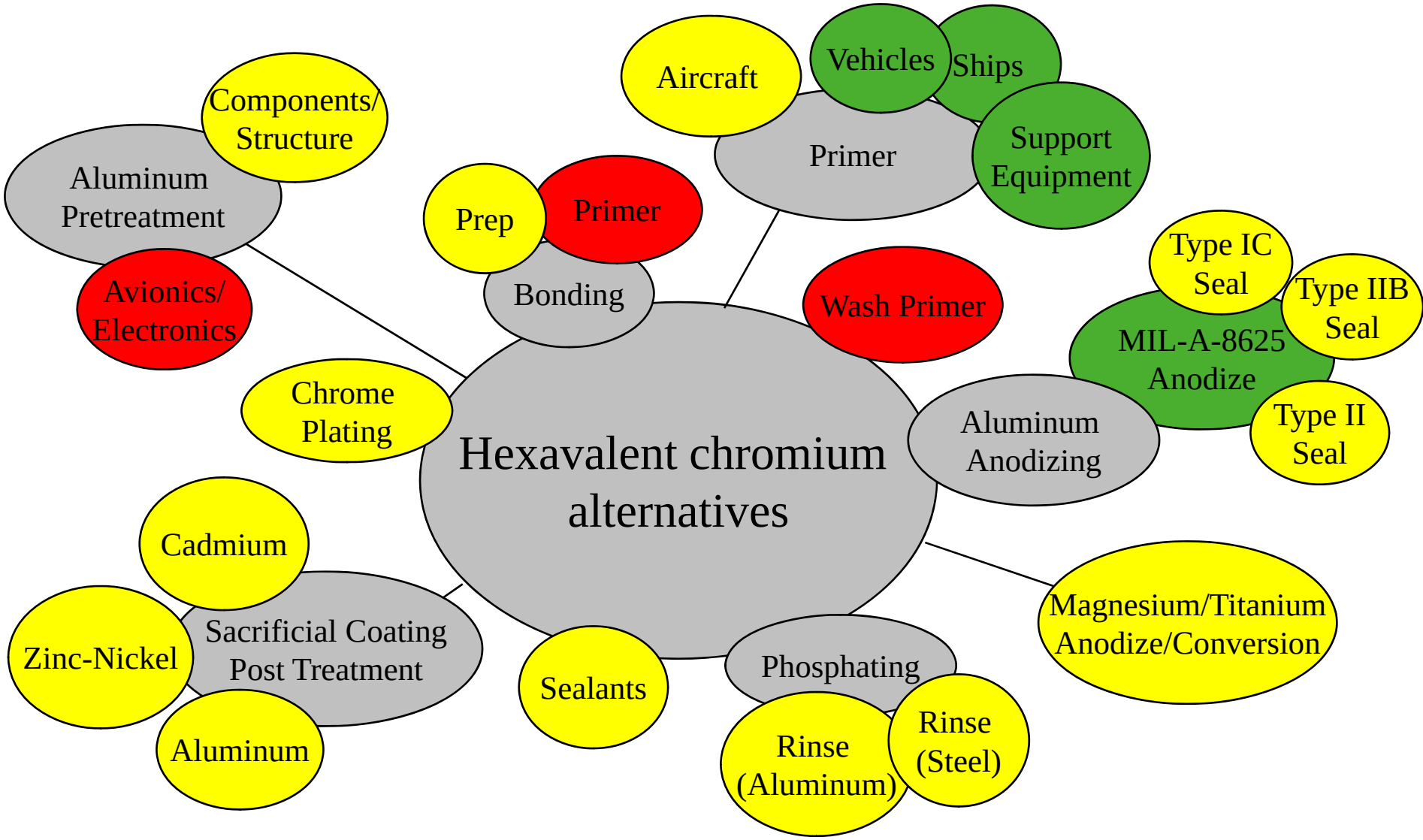
Application Areas for Chromate Alternatives

Green: Alternatives implemented; niche chromate use remains
Yellow: Limited implementation; near-term validation
Red: No or very limited implementation

Slide courtesy of NAVAIR



Accelerated Corrosion Testing

- Qualification of alternative corrosion-resistant coating systems requires accelerated test methods that represent real-world conditions and result in same mechanisms of corrosive attack

Allan Grobin, IBM Corporation, member of ASTM Committee G-1 (corrosion-related), October 5, 1977: "The salt spray test while initially developed as a corrosion test was very quickly found not to be a corrosion test. Many of the metal plating specifications disqualified the salt spray test as a corrosion test. It is a comparative test for quality control and should not be used as an evaluator of corrosion resistance. It should not be used to compare the resistance of one type of plating against another."

In 2010, the salt spray test (ASTM B117) is still being specified in qualifying alternative coating systems

Technician loading test panels into salt-fog (salt spray) test cabinet (ASTM B117)

Dynamic Accelerated Corrosion Test Protocol

Because qualification of alternative coating materials and processes is critical, SERDP decided to issue Statement-of-Need for development of accelerated test methodology

Objective

- **To develop an accelerated corrosion testing protocol that more accurately reflects the operational environments of Department of Defense (DoD) end users and would be acceptable across the DoD.**

Focus

- **Stress new protective systems in an effort to understand how they perform compared to the standard systems that are currently in use.**
- **Use several material "stack-up/mock-up" geometries selected from those currently being used by the military services.**
- **Ability to adjust protocol to provide accurate predictive data for most operational environments, ranging from land-based ground vehicles to carrier-based aircraft.**

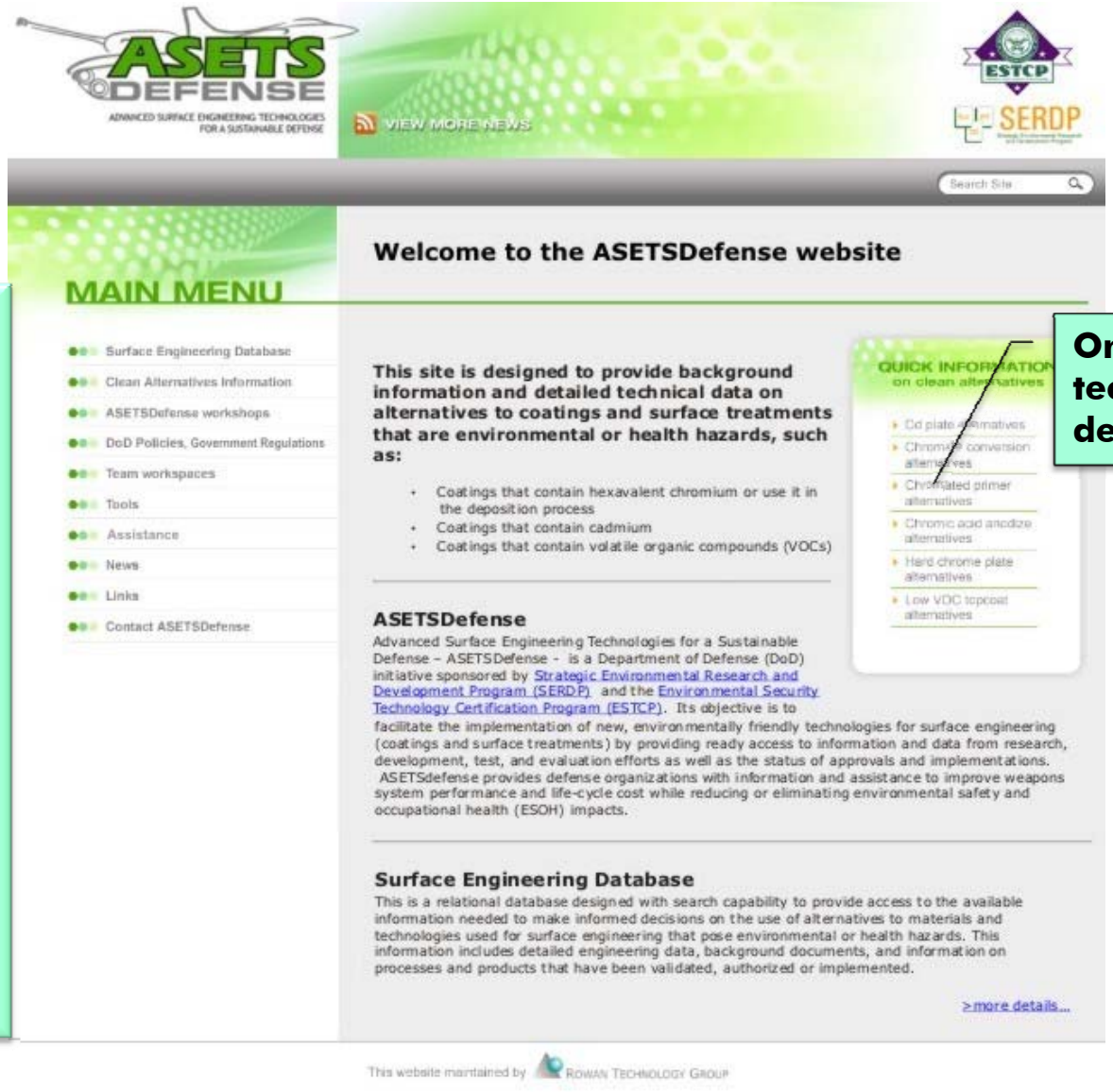
Example of Requirements for New Coating Implementation

- **Implementation Path**
  - **Lab validation – process and product performance**
  - **Field validation – process and product performance**
- **Implementation**
  - **Sign-Off**
    - **Engineering/Materials**
    - **Depot/Production**
    - **Program: Fleet Support Team (FST)/Class Desk/OEM**
  - **Revise specs (Local/MIL/AMS…)**
  - **Revise General Series and Equipment Manuals**

SERDP/ESTCP Initiative

- **Numerous surface-engineering-related projects executed by SERDP, ESTCP and other organizations to develop and evaluate new technologies that are more environmentally friendly and reduce life-cycle costs**
- **Problem is that stakeholders and weapons systems owners do not have ready access to data to determine if new technology can be implemented**
- **ASETSDefense is initiative intended to develop information data bases and organize workshops associated with technologies in the surface engineering field; web site www.asetsdefense.org is entry point to engineering data and materials selection data bases under development**

www.asetsdefense.org



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- Clean Alternatives Information
- ASETSDefense Workshops
- DoD Policies, Government Regulations
- Team Workspaces
- Tools
- Assistance
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- Contact ASETSDefense

Submenus drop down on click

One-page technology descriptions